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Report on the Diesel fuel tax
in Ontario.

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DEPARTMENT OF TRANSPORT

RESEARCH BRANCH

REPORT
ON THE
DIESEL FUEL TAX
IN
ONTARIO

MARCH 1958

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RESEARCH BRANCH



REPORT

ON THE

DIESEL FUEL TAX

IN

ONTARIO

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MARCH 1958

REPORT ON THE DIESEL FUEL TAX IN ONTARIO

Foreword

On April 1, 1957, the tax on diesel fuel purchased for consumption by motor vehicles in Ontario was raised to 20¢ per gallon. Since the tax on gasoline remained at 13¢, the change introduced an extra tax on diesel fuel of 7¢ per gallon, equivalent to 54 per cent. The purpose of this additional tax is to ensure that the revenue contribution per ton-mile made through the fuel tax by a given diesel powered motor vehicle shall be approximately equal to that made by a gasoline powered vehicle, operated under the same conditions, which is closely similar in respect of such cost-causing factors as type, gross weight, dimensions and speed.

Since April 1st, 1945 almost three-quarters of total highway revenue in Ontario has been obtained from taxes on the various types of motor fuel. This situation may continue for a long time to come. The advantage of this form of taxation is that it takes account of the mileage travelled by motor vehicles on the highways. If all vehicles obtained the same ton-miles per gallon, they would pay for their use of the highways at the same rate through the fuel tax. However, owing to the use of different kinds of fuel, such is not the case. It follows that positive action is required to ensure that the payments for highway use made by diesel and gasoline powered motor vehicles, similar in every respect except the rate of fuel consumption, are as far as possible equalized.


When the Department of Transport was formed one of the major functions assigned to it was research in highway user taxation.

The Prime Minister, the Honourable Leslie M. Frost, Q.C., stated in the Legislature on February 28th, 1957, that "under this Department could be determined the proper cost responsibility of various types and weight groups of highway users, so that a fair and proper programme of taxation can be developed for the Province". In order to assess the proper relationship of diesel fuel taxation to gasoline tax the Honourable James N. Allan, Minister of Transport, directed that the diesel tax rate should be reviewed by the Research Branch of the Department. This study was conducted in cooperation with the Ontario Research Foundation, an independent, fact-finding organization.

The Department would like to acknowledge the excellent cooperation received from the Automotive Transport Association of Ontario, the Canadian Transit Association, the Ontario Association of Motor Coach Operators and members of these associations. The complete facilities of the Department were made available to the Foundation. The report of the Foundation is given in its entirety on pages 1 to 11.

The research study was conducted under the direction of D. B. De Lury, M.A., Phd., and Messrs. D. R. Christie, M.A. and J. N. Matthews, B.A., Sc., P. Eng.

It was realized at the outset that reliable results could be obtained only through a designed experiment, the planning of which was entrusted to the Research Foundation. It must be stressed that for a number of reasons conclusions derived by other methods, for example the study of company data, are seldom valid. Thus, definitions vary and the degree of accuracy with which different operators obtain and record their information is not uniform.



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Unless specific precautions are taken, important factors exert their influence in uncontrolled fashion.

The performance of two classes of vehicle, tractor-semitrailer combinations and buses, both gasoline and diesel powered, was examined. Combinations with registered gross weights of 58,000 and 68,000 pounds were selected. The choice of other weight groups was considered, but it was found that these two weight groups contain a significant proportion of the total number of diesel powered trucks and combinations in Ontario and that gasoline vehicles are well represented within them. Thus, they could be expected to provide representative comparisons.

Combinations with a registered gross weight of 58,000 pounds were observed over the Toronto-Montreal and Toronto-Sudbury routes: those with a weight of 68,000 pounds over the Toronto-Sault Ste. Marie and Toronto-Hamilton routes. Approximately 15 observations were obtained for each fuel type (gasoline or diesel) in each direction over each route, giving a total of some 240 observations. Data for city buses were obtained from matched runs in Toronto, Ottawa, Hamilton and Windsor: those for suburban buses from the Toronto-Hamilton route and those for inter-city buses from runs originating in Windsor, Ottawa, Hamilton and Toronto.

Each combination included in the test was accompanied by a Public Commercial Vehicle inspector from the Ontario Department of Transport. The inspectors were provided with specially devised record forms and carefully instructed as to how they should complete them. In the case of buses, it was considered that in view of the regular

nature of their operations observers were in general not required. Nevertheless, for some 10 per cent of the total number of bus runs observers were provided as a check.

The amount of fuel consumed was obtained in the following manner. The tank of each vehicle was filled at the commencement and re-filled at the termination of its run. The quantity required for re-filling was taken as the amount consumed. Mileage run was calculated from recorded odometer readings. Scale weight was measured at Government-operated weigh stations.

ONTARIO RESEARCH FOUNDATION

Department of Mathematical Statistics

Report on the Investigation of the Rate

of Fuel Consumption of Gasoline and Diesel Powered Vehicles

The purpose of this investigation is to compare gasoline and diesel powered vehicles with respect to their fuel consumption per ton-mile. In principle, this amounts simply to finding out, for each of a number of vehicles, the distance travelled on a given run, the total weight and the amount of fuel consumed. Obviously the rate of fuel consumption varies with the nature of the run. Therefore, comparisons of gasoline and diesel powered vehicles must be made only over the same run. Also, this comparison may vary with the size and type of vehicle (tractor-trailers, buses, trucks, etc.). For this reason, the investigation is carried out in several segments, each concerned with a particular type of vehicle. Lastly, the belief is widely held that the difference between gasoline and diesel powered vehicles of the same type and size varies from one kind of run to another. The study has been designed with this belief in mind.

Sections I and II deal with tractor-trailers in the 53000 pound and 68000 pound weight classes. Section III is devoted to buses in various kinds of service.

Section I. Tractor-trailers, 53000 pound class

1. Toronto - Montreal Run

The data are tabulated at the end of this section. The

number sought from these records is "gallons per ton-mile", multiplied by 1000 to bring it to a convenient numerical magnitude. This ratio is calculated for gasoline and for diesel powered vehicles separately for each direction over the route.

The values obtained for the ratio $\frac{\text{gals.} \times 1000}{\text{tons} \times \text{miles}}$ from the Toronto-Montreal tests are assembled in the following table:

<u>Run</u>	<u>Fuel</u>	<u>gals. x 1000</u> <u>tons x miles</u>	<u>Ratio Gas/Diesel</u>
Toronto to Montreal	Gasoline	7.59	1.45
	Diesel	5.23	
Montreal to Toronto	Gasoline	8.03	1.42
	Diesel	5.64	

2. Toronto - Sudbury Run

The data from this run have been treated in the same manner as those from the Toronto - Montreal run. One factor enters into this comparison which did not in the Toronto - Montreal run. It turned out that, with few exceptions, trucks going from Toronto to Sudbury were heavily loaded, whereas trucks going from Sudbury to Toronto were empty or at most lightly loaded. The results reported in the tables below show that trucks with little or no load produce values of gallons per ton-mile much greater than those of loaded trucks. Therefore, the trucks were divided into groups, called heavy and light by making an arbitrary division at 20 tons. The main comparisons are therefore in the heavy group, Toronto to Sudbury and in the light group Sudbury to Toronto. Only fragmentary information occurs in the other categories. It appears, from the results tabulated below, that the difference in

fuel consumption per ton-mile between gasoline and diesel powered trucks increases as the load increases.

The dependence of fuel consumption per ton-mile on weight raises a question concerning the validity of the gas-diesel comparison within weight groups. Conceivably, this could be distorted by different distributions of weights in the two classes. An inquiry into this question indicates that no appreciable bias enters in this manner.

The following table contains the estimates of gallons per ton-mile obtained in the Toronto - Sudbury tests. The results from the Toronto - Montreal tests are brought forward into the same table, so that the whole of the results of this section may be seen together.

<u>Run</u>	<u>Fuel</u>	<u>gals. x 1000</u> <u>tons x miles</u>	<u>Ratio Gas/Diesel</u>
Toronto to Montreal	Gasoline	7.59	1.45
	Diesel	5.23	
Montreal to Toronto	Gasoline	8.03	1.42
	Diesel	5.64	
Toronto to Sudbury (heavy)	Gasoline	8.42	1.46
	Diesel	5.78	
Sudbury to Toronto (light)	Gasoline	14.95	1.35
	Diesel	11.05	

The individual estimates of gallons per ton-mile are not very precise, as each of them is based on records from only about fifteen trucks. The standard errors of these estimates range from about 0.2 for the smaller values to 0.3 for the larger ones. However, the fact that the values of the Gas/Diesel ratio remain virtually constant from one

run to another gives good assurance that the results warrant high confidence.

Section II. Tractor-trailers, 68000 pound class

Operations in this weight class, in which both gasoline and diesel powered vehicles are used, are not numerous. Apparently only two are large enough to permit trials of the sort used in this study, one operating between Hamilton and Toronto, the other between Sault Ste. Marie and Toronto.

1. Hamilton - Toronto Run

In this operation, steel is hauled from Hamilton to Toronto and the trucks return with any loads they can find. Consequently the total weights on the return trip from Toronto to Hamilton vary widely. Up to the date when the present investigation was concluded, the number of these runs reported was low, but in view of the wide range of weights, it seemed profitless to seek more data of this kind. The gas/diesel ratio is therefore based entirely on records obtained from the run from Hamilton to Toronto.

The following table shows a summary of the data from the

Hamilton - Toronto run.

Hamilton to Toronto

Total Weight (tons)	Number	<u>Diesel</u>		Number	<u>Gasoline</u>		Gas/Diesel
		Av.	<u>gals. x 1000</u> <u>Tons x Miles</u>		Av.	<u>Gals. x 1000</u> <u>Tons x Miles</u>	
20 - 22	0		-	1		10.04	
22 - 24	1		5.37	0		-	
24 - 26	0		-	0		-	
26 - 28	1		(5.32	1		5.98)	
28 - 30	1		(5.72	2		7.56)	1.36
30 - 32	0		(-	2		8.14)	
32 - 34	11		4.40	8		7.61	1.73
34 - 36	9		4.59	3		7.62	1.66

Toronto to Hamilton

Total Weight (tons)	Number	<u>Diesel</u>		Number	<u>Gasoline</u>		Gas/Diesel
		Av.	<u>Gals. x 1000</u> <u>Tons x Miles</u>		Av.	<u>Gals. x 1000</u> <u>Tons x Miles</u>	
20 - 22	2		5.82	1		11.44	
22 - 24	1		5.25	4		10.74	
24 - 26	0		-	2		10.80	
26 - 28	0		-	0		-	
28 - 30	1		4.56	1		10.33	
30 - 32	0		-	1		6.87	
32 - 34	1		5.14	0		-	
34 - 36	0		-	0		-	
36 - 38	0		-	1		9.33	

The only estimates in this table that have any worthwhile precision are those in the range 32 - 36 tons (those vehicles were fully loaded). The gas/diesel ratio for these weight classes is about 1.7.

When the data obtained on the Toronto - Hamilton run are arranged in the same way, it is seen that no trustworthy estimates of the gas/diesel ratio can be formed.

2. Sault Ste. Marie - Toronto Run

The number of different trucks on this run is not large.

Records were obtained from five diesel trucks and ten gasoline trucks, usually several trips with each one. The following average values of the ratio $\frac{\text{gallons} \times 1000}{\text{tons} \times \text{miles}}$ were obtained.

	<u>Diesel</u>	<u>Gasoline</u>	<u>Gas/Diesel</u>
Toronto - Sault Ste. Marie	6.16	6.37	1.03
Sault Ste. Marie - Toronto	5.34	6.03	1.14

These ratios are in sharp contrast with those found for the Hamilton-Toronto run. This contrast cannot be attributed to errors of any kind. Presumably it reflects simply differences in the kind of equipment used in the two operations. It should be remarked that, while the diesel trucks on the Sault Ste. Marie run used somewhat more fuel per ton-mile than those on the Hamilton run, the gasoline trucks on the Sault Ste. Marie run used considerably less than those on the Hamilton run.

The trucks on the Sault Ste. Marie run are all fairly new. On the Hamilton run, the gasoline trucks are mostly considerably older than the diesel trucks.

Section III. Buses

The study of buses, owing to the nature of these operations, had to be carried out along somewhat different lines from those employed with trucks. No manageable way of measuring total weight is available in the ordinary operation of a bus and the load is likely to change appreciably during a run. In order to obtain a legitimate comparison between gasoline and diesel buses, matched runs over the same route were used, in the expectation that the loads would be nearly equalized. The empty weights of the buses were used to compute ton-miles.

1. Inter-urban Buses

The difficulty in this portion of the study is that, on each run, there are only a few buses. Consequently, each estimate of the gas/diesel ratio has little precision.

The individual items in the data have little interest in themselves. Only the value of the ratio is recorded here.

<u>Run</u>	<u>Number of Gasoline Buses</u>	<u>Number of Diesel Buses</u>	<u>Gas/Diesel Ratio</u>
Windsor-Leamington	1	1	1.68
Ottawa-Cornwall	1	1	2.14
Hamilton-Guelph	1	3	1.46
Hamilton-Brantford	3	2	1.85
Hamilton-Simcoe	2	2	1.82
Hamilton-Niagara Falls	2	3	1.51
Toronto-Beaverton	5	6	1.78
Average			1.75

2. Suburban Buses

<u>Run</u>	<u>Number of Gasoline Buses</u>	<u>Number of Diesel Buses</u>	<u>Gas/Diesel Ratio</u>
Toronto-Hamilton	4	13	1.46

3. City Buses

Toronto

<u>Run</u>	<u>Number of Gasoline Buses</u>	<u>Number of Diesel Buses</u>	<u>Gas/Diesel Ratio</u>
Broadview Run 1	9	5	1.66
Broadview Run 2	9	5	1.79
Broadview Run 3	8	4	1.32
Davisville Run 1	7	7	1.60
Davisville Run 3	6	6	1.38
Davisville Run 4	1	1	1.42
Average			1.53

Ottawa

Riverdale-Hull	4	2	1.95
Crosstown	3	2	1.76
Average			1.86

Hamilton

<u>Run</u>	<u>Number of Gasoline Buses</u>	<u>Number of Diesel Buses</u>	<u>Gas/Diesel Ratio</u>
Main West Run 2	1	1	1.41
Locke Run 1	1	1	1.47
Locke Run 4	1	1	1.14
Queensdale Run 3	1	1	1.78
Queensdale Run 10	1	1	1.86
Aberdeen Run 6	1	1	1.90
Average			1.59

Windsor

Oulette	5	7	1.50
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Comments on Section III

The large variation encountered among the ratios in the study of buses is not unexpected, in view of the small number of buses used in most of the comparisons. While the measurements themselves (miles travelled and fuel consumed) are subject to some error and loads may not be wholly equalized, it is likely that the major part of this variation stems from large differences among the individual buses that were used in the test.

On the whole, the gasoline buses in these tests were appreciably older than the diesel buses. This might, in part, account for the rather high gas/diesel ratios, because the rate of consumption of fuel does increase with the age of the engine.

Summary and Discussion

A condensation of the results listed in the report is given in the following table. The numbers called gas/diesel ratios are obtained by calculating the rate of fuel consumption, in gallons per ton-mile, for gasoline and diesel powered vehicles and taking the ratio of these two rates.

<u>Type of Vehicle</u>	<u>Route</u>	<u>Average gas/diesel ratio</u>
58000 pound tractor-trailer	Toronto-Montreal	1.44
58000 pound tractor-trailer	Toronto-Sudbury	1.40
68000 pound tractor-trailer	Toronto-Hamilton	1.58
68000 pound tractor-trailer	Toronto-Sault Ste. Marie	1.08
Interurban bus	7 different routes	1.75
Suburban bus	Toronto-Hamilton	1.46
City bus	Toronto	1.53
City bus	Ottawa	1.86
City bus	Hamilton	1.59
City bus	Windsor	1.50

Several facts should be kept in mind in reaching any decision based on these ratios.

1. The comparisons in the 58000 pound tractor-trailer group are more representative and trustworthy than those in the other groups, because they are based on fairly large samples of both gasoline and diesel

vehicles which do not differ seriously with respect to age or loads carried. Furthermore, this type and class of diesel vehicle is more numerous than any other. Hence no single ratio, intended to serve for all types and classes, should be allowed to deviate far from the one determined for this class, i.e. 1.42.

2. On the whole, the gasoline vehicles in this study were appreciably older than the diesel vehicles. While this reflects the state of these operations to-day, it may be expected that, as the older vehicles pass out of service and are replaced by new ones, the gas/diesel ratio will diminish.

3. The wide disparity among the ratios found for the various bus operations reflects chiefly the characteristics of the individual buses which were used in the tests. For most part, they were few in number. On this score, the results on Toronto city buses are more trustworthy than the others. However, the gasoline buses in Toronto are, on the average, considerably older than the diesel buses.

It is now necessary to consolidate the results which have been reported and to arrive at a single figure with which the present diesel fuel tax rate of 20 cents per gallon may be compared.

The average ratios of Gasoline consumption per 1,000 ton-miles
Diesel Fuel consumption

summarised in the last table of the Foundation's report, yield mean ratios of 1.375:1 and 1.620:1 for combinations and buses, respectively. If use is to be made of these ratios, then account must be taken of the relative importance of trucks and buses as consumers of taxable diesel fuel.

Estimates made by the Dominion Bureau of Statistics for the calendar year 1956 are as follows:

Estimated Volume of Diesel Fuel Consumed by Motor Vehicles
Ontario 1956

<u>Class of Vehicle</u>	<u>Diesel Fuel Consumption</u> (Gallons)
Trucks and Tractors	6,473,000 ⁽¹⁾
Buses:	
(1) Urban	2,676,738 ⁽³⁾
(ii) Intercity	1,587,000 ⁽²⁾
	<hr/> 4,263,738
Total	<hr/> 10,736,738 <hr/>

(1) "Motor Transport Traffic Statistics, Province of Ontario, 1956"
Diesel fuel consumed by trucks and tractors within the Province.

(2) Do. for intercity buses.

(3) "Urban Transit Statistics, 1956"

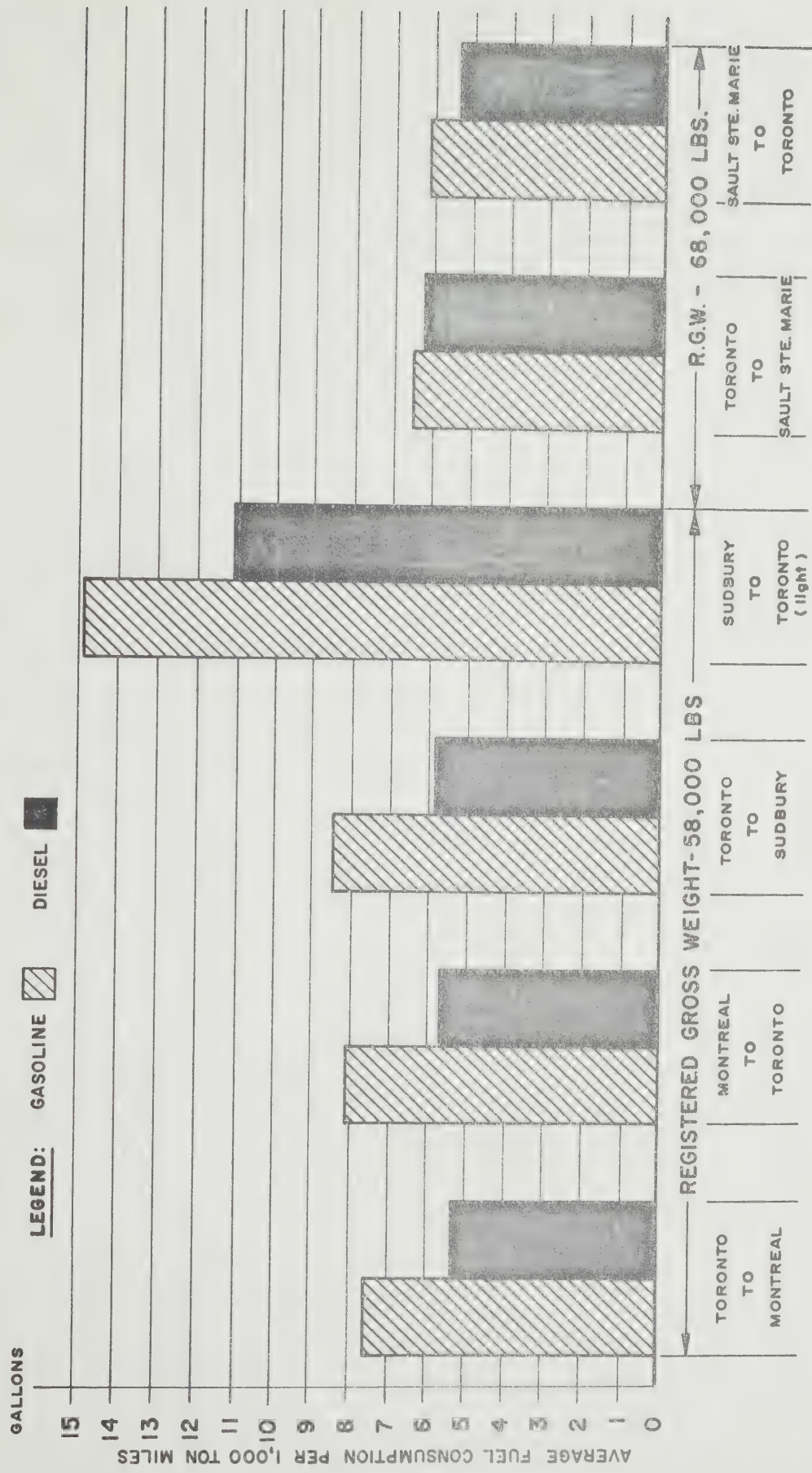
The D.B.S. estimates of diesel fuel consumption by intercity and urban buses are well substantiated by figures obtained directly by the Research Branch from the larger bus operators in Ontario.

Allowing for these different volumes, there emerges a weighted average ratio of 1.47: 1 for trucks and buses combined. Substantial

justification could be found for using this ratio, since it reflects - with considerable accuracy - the average differential in rate of fuel consumption between gasoline and diesel powered motor vehicles, and it is through these vehicles that tax payments are now being made. This would indicate a tax rate of 19.1 cents per Imperial gallon of diesel fuel. The Foundation established that the comparisons of the 58,000 pound tractor-trailer group are more representative and trustworthy than those of other groups and that therefore no single ratio should be allowed to deviate far from the one determined for this class, 1.42:1. The tax rate based on this ratio would be 18.46 cents per Imperial gallon of diesel fuel when compared with a 13 cent tax per Imperial gallon of gasoline.

It is recommended that the tax on diesel fuel should be 18.5 cents per Imperial gallon.

COMPARATIVE RATES OF FUEL CONSUMPTION FOR GASOLINE AND DIESEL POWERED COMBINATIONS ON SELECTED RUNS IN ONTARIO, WINTER 1957 - 58



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